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Guidelines for the Development of Annual and Long Range Pavement Work Plans Using PAVER

by
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This report presents step-by-step guidelines for using PAVER to develop annual and long range work plans at installations. Use of the guidelines will promote uniformity in reporting installation maintenance and repair requirements to be compared for funding at the major command level. Example annual and long range work plans are given for a small set of data from an Army installation.

Based on demonstrations at Fort Hood, TX, Fort Knox, KY, and Seneca Army Depot, NY the process of developing annual and long range work plans should be further automated to be a single PAVER system report and the pavement family curve prediction method should be incorporated into PAVER reports.

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13. ABSTRACT *(Maximum 200 words)*

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FOREWORD

This report was prepared for the U. S. Army Engineering and Housing Support Center (USAEHSC) under the Facilities Engineering Applications Program (FEAP) Work Unit FEAP-MB-F19. "PAVER/Micro PAVER Demonstration." The Technical Monitor was Mr. Ken Gregg, CEHSC-FB-P.

This research was performed by the Engineering and Materials Division (EM) of the U. S. Army Construction Engineering Research Laboratory (USACERL). Dr. R. Quattrone is Chief of EM. The Technical Editor was Gloria J. Wienke, Information Management Office.

COL Carl O. Magnell is Commander and Director of USACERL and Dr. L. R. Shaffer is Technical Director.

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GUIDELINES FOR THE DEVELOPMENT OF ANNUAL AND LONG RANGE PAVEMENT WORK PLANS USING PAVER

1 INTRODUCTION

Background

Army installation Directorate of Engineering and Housing (DEH) personnel are charged with identifying pavement sections that are predicted to be below a minimum acceptable condition and scheduling the sections for repair. Although small repair projects are scheduled and completed annually, major projects require more intensive planning and are usually scheduled for 1 to 6 years in the future. In accordance with Army Regulation (AR) 420-72[1], the DEHs currently forward these annual and long range work plans to the respective major commands (MACOMs) for information and planning. Because the MACOMs need uniform reporting to compare maintenance and repair (M&R) and funding requirements, the DEHs need standard guidelines for preparing the annual and long range work plans.

The PAVER system (Figure 1), developed by the U.S. Army Construction Engineering Research Laboratory (USACERL), provides the ideal environment for creating standardized work plans. The system includes a mainframe version (PAVER) and a microcomputer version (Micro PAVER) and provides Army installation DEHs with an easy-to-use decisionmaking tool for pavement maintenance management.[2] System capabilities include data storage and retrieval, pavement condition prediction, budget planning, determination of M&R needs, and economic analysis. New system reports that facilitate the development of annual and long range work plans include: the Family Analysis Report, the Budget Condition Forecasting (BCF) Report, and the Preventive Maintenance Report.

The PAVER system can help DEH personnel prioritize the pavement sections requiring maintenance and/or repair. At the project level, the PAVER system can help the engineer choose the best maintenance and rehabilitation alternative. The goal of this technology is to maximize the pavement condition with the available funds. Several engineering studies have shown that the most economical way to preserve pavements is through preventive and timely application of the correct maintenance alternative.[3] Figure 2 is a schematic diagram of a typical pavement condition life cycle showing the significant increase in maintenance cost if the pavement is allowed to deteriorate below a certain condition.

The pavement condition rating used in PAVER is the Pavement Condition Index (PCI), which is based on the type, quantity, and severity of distresses present, as shown in Figure 3.[4] It is a repeatable index measured on a scale of 0 to 100 that agrees closely with the collective judgment of maintenance engineers.

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[1]Army Regulation (AR) 420-72, *Surfaced Areas, Railroads, and Associated Structures* (Headquarters, Department of the Army [HQDA], 24 March 1976).

[2]M.Y. Shahin, J.A. Walther, and K.A. Cation, *Pavement Maintenance Management for Roads and Parking Lots Using the PAVER System*, Technical Report M-90/05 (U.S. Army Construction Engineering Research Laboratory [USACERL] March 1990).

[3]K.J. Feighan, et al., "A Prioritization Scheme for the Micro PAVER Pavement Management System," a paper presented at Transportation Research Board Conference, January 1989, E.A. Sharaf, M.Y. Shahin, and K.C. Sinha, "Analysis of the Effect of Deferring Pavement Maintenance," in *Transporation Research Record 1205* (Transportation Research Board, January 1988).

[4]M.Y. Shahin, M.I. Darter, and S.D. Kohn, *Development of a Pavement Maintenance Management System*, Vol III: "Maintenance and Repair Guidelines for Airfield Pavements," AFCEC-TR-44 (AFCEC, October 1977).

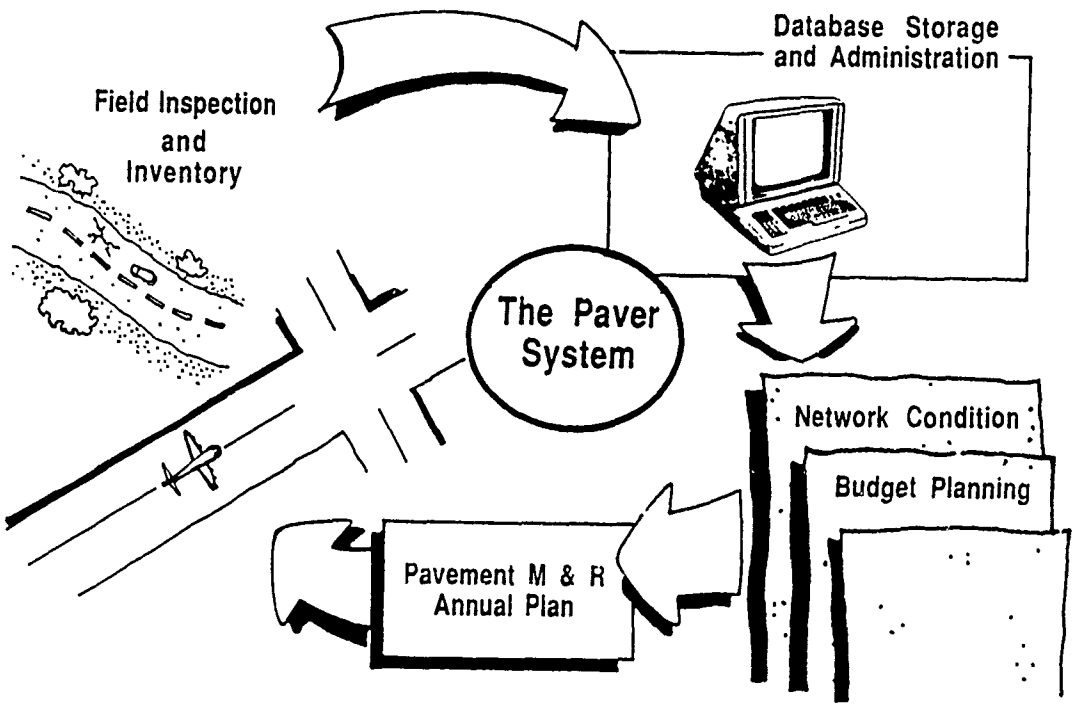

Figure 1. The PAVER system.

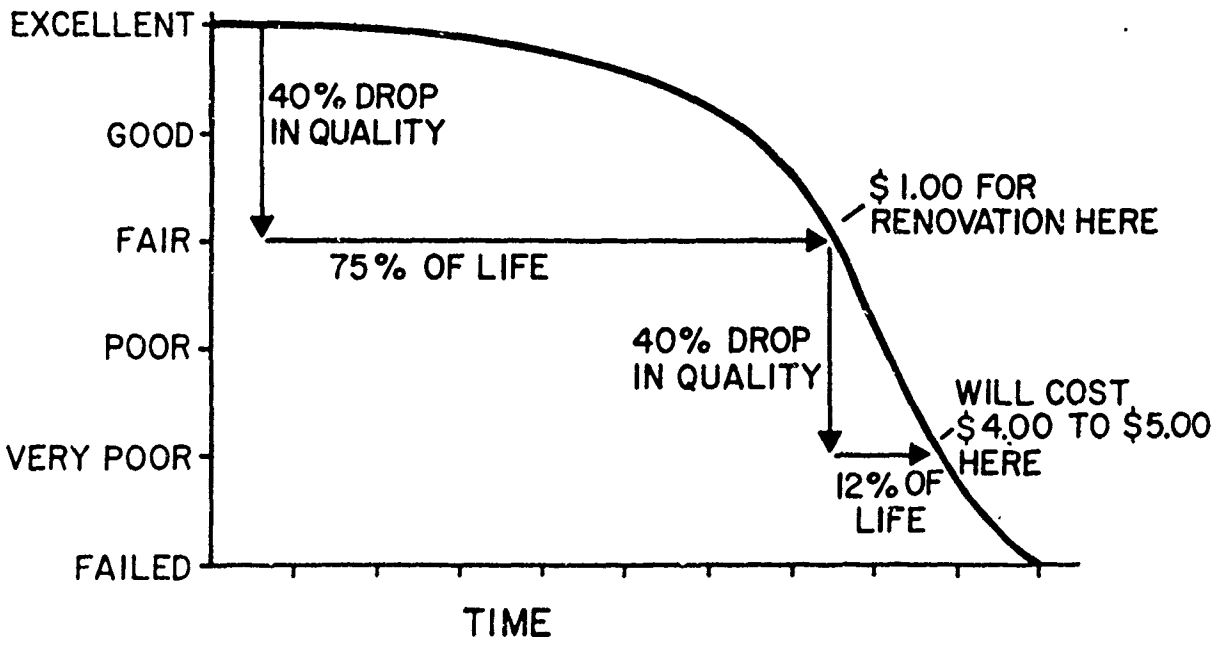

Figure 2. Typical pavement condition life cycle.

Objective

The objective of this research is to provide step-by-step guidelines for developing annual and long range work plans (AWP and LRWP) and to demonstrate use of the guidelines at selected Army installations.

Approach

The annual and long range work planning method described in this paper was developed based on informal feedback from PAVER users. It was then demonstrated at three Army installations: Fort Hood, TX; Fort Knox, KY; and Seneca Army Depot, NY. These sites were chosen based on discussions with the MACOM pavement engineers at Forces Command (FORSCOM), Training and Doctrine Command (TRADOC), and Army Materiel Command (AMC). Researchers used PCI data from the mainframe PAVER to develop annual and long range work plans for the primary road network at each installation before the demonstration. DEH personnel were trained to use PAVER for the annual and long range work plan by developing work plans for the remaining installation roads.

Mode of Technology Transfer

These guidelines were developed in conjunction with a revision to AR 420-72, prepared by the U.S. Army Engineering and Housing Support Center (USAEHSC). No other Army documents will be affected. A videotape of the procedure will be produced and distributed through USAEHSC.

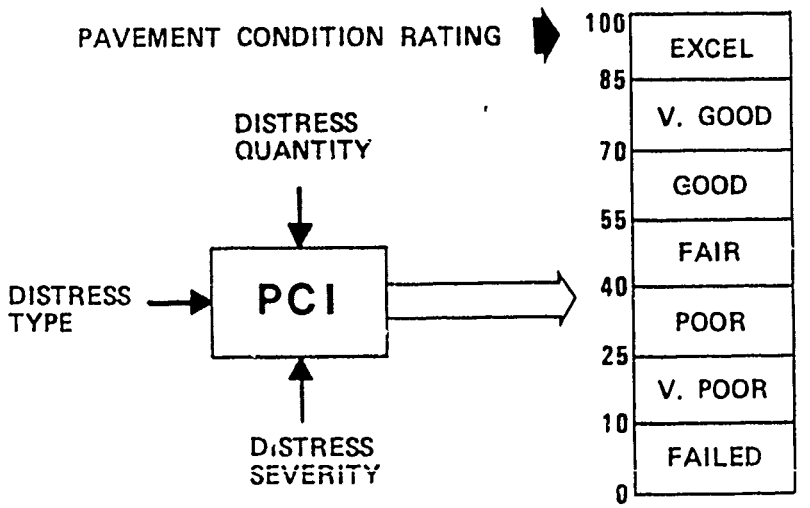

Figure 3. Pavement Condition Index (PCI).

2 ANNUAL WORK PLAN

An AWP consists of the Annual Recurring Requirements (ARR) and Programmed Year Projects (PYP which is any major repair). The following PAVER reports are used to develop them.

- The PCI Report lists the pavement section numbers and the area, age, and PCI from the latest inspection.

- The Family Analysis Report and Section Prediction Report provide a best-fit curve for predicting future PCI based on pavement age and groupings by homogeneous families of structure and use.

- The Budget Condition Forecasting Report estimates future annual budgets to maintain the pavement above a minimum PCI.

- The Network Maintenance Report estimates M&R costs based on a previously defined distress maintenance policy.

- The Preventive Maintenance Report provides (1) a summary of the localized and global preventive maintenance requirements and (2) a list of pavements with structural distress having a PCI above a specified minimum PCI.

Annual Recurring Requirements

The ARR consists of activities classified as either preventive or safety M&R. Preventive M&R consists of both localized maintenance (e.g., crack sealing and patching) and global maintenance (e.g., surface sealing). Safety M&R involves pothole patching and lane shoulder drop-off leveling. These tasks should be fully funded in accordance with AR 420-72.

Preventive M&R

Preventive M&R consists of localized and global maintenance activities that slow the deterioration rate to preserve the pavement investment. Localized preventive maintenance includes crack sealing and various patching techniques, as shown in Figure 4. Global preventive maintenance includes various methods of surface sealing for asphalt pavements and joint sealing for concrete pavements, as shown in Figure 5.

An example of a PAVER localized preventive maintenance policy for asphalt surfaced roads is shown in Figure 6. The policy addresses only localized maintenance for each distress type/severity combination and should be applied only to pavements above the Critical PCI. The Critical PCI is defined as the PCI value below which the pavement shows a significant increase in both the rate of deterioration and preventive maintenance cost. Figure 7 is a schematic diagram of a typical deterioration curve showing the recommended range of the Critical PCI value. The Critical PCI is usually between 55 and 70. Selection of the Critical PCI value depends on the pavement network and family of pavements under consideration. A value of 55 is most likely to be selected unless an unreasonable preventive maintenance cost is determined at or near the 55 level. If so, a higher value should be used. The Family Analysis Report and the Network Maintenance Report are used in identifying the Critical PCI value as described later in this chapter.

The selection criteria of the Preventive Maintenance Report allow the user to specify which maintenance policy to apply to pavement sections above the Critical PCI. This report is very useful in identifying both localized and global preventive maintenance needs.

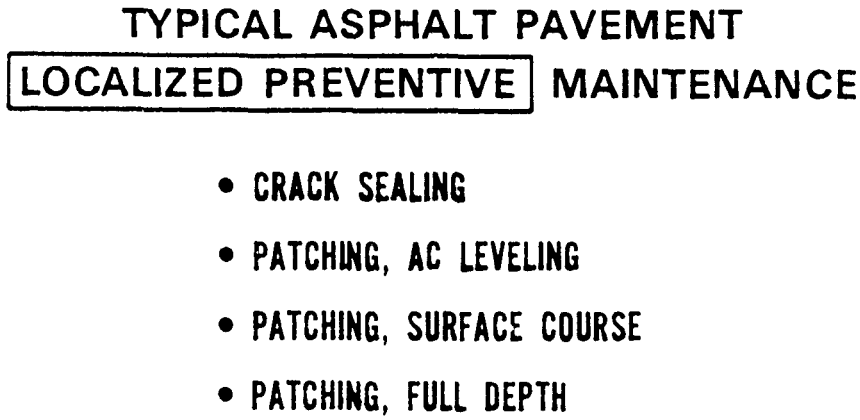

Figure 4. Typical asphalt pavement localized preventive maintenance.

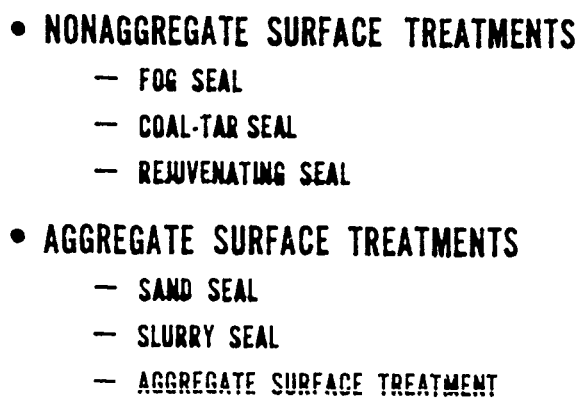

Figure 5. Typical asphalt pavement global preventive maintenance.

DIST	SEV	MAINT	COST/$	UNIT
ALLIGATOR CRACKING	M & H	PATCHING FULL DEPTH	5.0	SY
BLOCK CRACKING	M & H	CRACK SEALING	0.6	LF
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Figure 6. Example localized preventive maintenance policy.

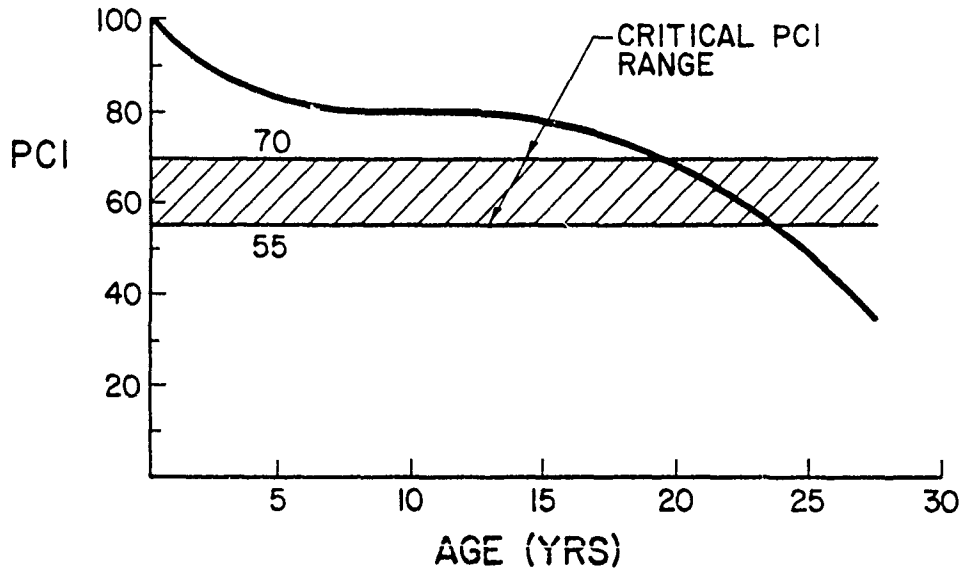

Figure 7. Critical PCI range.

Global preventive maintenance is recommended for those asphalt pavement sections having a PCI above the Critical value and showing no structural distress. The specific type of maintenance depends on the age of the pavement, its use, and existing distresses. For example, a pavement with weathering and raveling will benefit from a fog seal or a rejuvenator. A pavement with a smooth surface or skid problem should not be treated with a rejuvenator but should be considered for a chip or slurry seal or should be programmed for a thin overlay (see the section on Programmed Year Projects). Global preventive maintenance for Portland cement concrete (PCC) pavements usually consists of joint sealing.

Safety M&R

Safety M&R consists of localized repairs needed to keep the pavement safe. An example of a localized safety M&R policy for asphalt surfaced roads is shown in Figure 8. The complete policy would address localized M&R for each distress type/severity combination. Localized safety should be applied only to those pavement sections not selected for preventive maintenance. For example, if all sections with a PCI over 60 receive preventive maintenance, all sections at or below 60 should receive safety M&R. The localized safety policy is actually a small portion of the preventive maintenance policy.

Although major repair may be scheduled for some pavement sections, the time needed to plan and complete the repair may leave the sections unsafe for some time. Safety M&R is intended to ensure that the pavement is usable and safe in the interim before major repair.

The localized safety maintenance requirements are easily generated using the Network Maintenance Report. The selection criteria of the report allow the user to apply a specific safety policy to pavements below the Critical PCI. It should be noted that applying the preventive maintenance policy to pavement sections below the Critical PCI value is exorbitantly expensive and not cost effective in most cases. The lower the PCI, the higher the cost. It may be cheaper to reconstruct pavements with a PCI below the Critical value than to try to perform preventive maintenance.

DIST	SEV	MAINT	COST/$	UNIT
BUMPS	H	PATCHING, SURFACE	18.0	SY
POTHOLE	M & H	PATCHING, FULL DEPTH	45.0	SY

Figure 8. Example localized safety maintenance policy.

Programmed Year Projects

PYP includes all pavement sections at or below the Critical PCI as well as all sections above the Critical PCI that are beginning to show structural distress. Sections above the critical PCI and approaching the critical PCI shuld be funded along with the ARR.

If the budget permitted, performing the most cost-effective M&R on all the PYP sections would be desirable. However, this is not usually the situation. Therefore, it is important to prioritize the PYP sections to ensure the highest return on investment and to meet managerial constraints and preferences.

The number one priority should undoubtedly be given to pavement sections above the Critical PCI level that show structural distress. These sections are beginning to deteriorate rapidly, but the deterioration can be arrested and the pavement restored to good condition at a low cost if the rehabilitation is done promptly.

Other pavement sections can be prioritized according to the pavement condition and rank (functional classification). Figure 9 is a recommended priority scheme for the PYP sections.

The Budget Condition Forecasting Report, which is based on average repair costs for a given PCI, provides a quick tool for developing the PYP. This report is a combination of the Budget Planning Report and the PCI Frequency Report. It provides a 5-year budget plan estimating the annual rehabilitation cost required to maintain the pavement condition above a minimum standard. It also allows the user to project what effect varying this minimum standard has on the budget and gives an overall frequency of condition based on this minimum. Information in this report can be used to define the pavement network's condition, plan future M&R, and predict the impact of not performing any major repairs.

PCI RANGE	PAVEMENT RANK		
	P	S	T
56 TO CRITICAL PCI	2	4	7
41 TO 55	3	6	9
LESS THAN 41	5	8	10

Figure 9. Prioritization scheme for Programmed Year Projects.

Procedure Summary

The following is a step-by-step summary of the PAVER procedure for developing the AWP.

1. Determine the Critical PCI:

1.1. Use the PAVER Family Analysis Report to visually establish a range of possible Critical PCI values.

1.2. Select or establish preventive and safety maintenance policies for localized distress.

1.3. Apply the preventive maintenance policy to pavement sections in the identified Critical PCI range using the Network Maintenance Report. The Critical PCI value is the PCI at which the preventive maintenance costs begin to increase rapidly.

2. Develop AWP above the Critical PCI (Figure 10):

2.1. Use the Preventive Maintenance Report to identify the localized and global preventive maintenance needs.

2.2. The Preventive Maintenance Report also identifies those pavement sections beginning to show structural distress and recommends them for project evaluation instead of global preventive maintenance. These sections should be reinspected to make sure the PCI is current (within last 6 months). The following analysis should be conducted:

a. Review distress data to verify the existence of structural distress. If structural distress does not exist or is very localized and the PCI is relatively high, the section should be removed from the project evaluation list.

b. Evaluate the rate of deterioration through the use of the Condition History Report. If an adequate budget is not available to perform M&R on all the sections, the sections with the highest rate of deterioration should be repaired first. For sections of approximately the same rate of deterioration, those with a lower PCI should be repaired first.

c. To obtain the estimated repair cost, run the BCF Report with a minimum PCI equal to 100 for all sections. Sort the output by branch number and section number.

3. Develop AWP at or Below the Critical PCI (Figure 11):

3.1 Using the Network Maintenance Report, apply the localized safety M&R policy to all pavement sections below the Critical PCI to identify the localized safety needs.

3.2 Determine major M&R for sections approaching the Critical PCI at the programmed year by running the BCF Report for all sections above the Critical PCI beginning with the programmed year. The selected minimum PCI should be equal to the Critical PCI. Sort the report output by year to repair, branch number, and section number. Examine the list of sections in the programmed year and make sure to subtract sections already identified in step 2.2.

It is recommended that the sections approaching the Critical PCI be verified using Section Prediction Report. This is needed since the current version of the BCF Report uses the straight line condition projection procedure rather than the family curve concept. If the results from the BCF and Section Prediction Report do not agree, the Section Prediction Report results should be used.

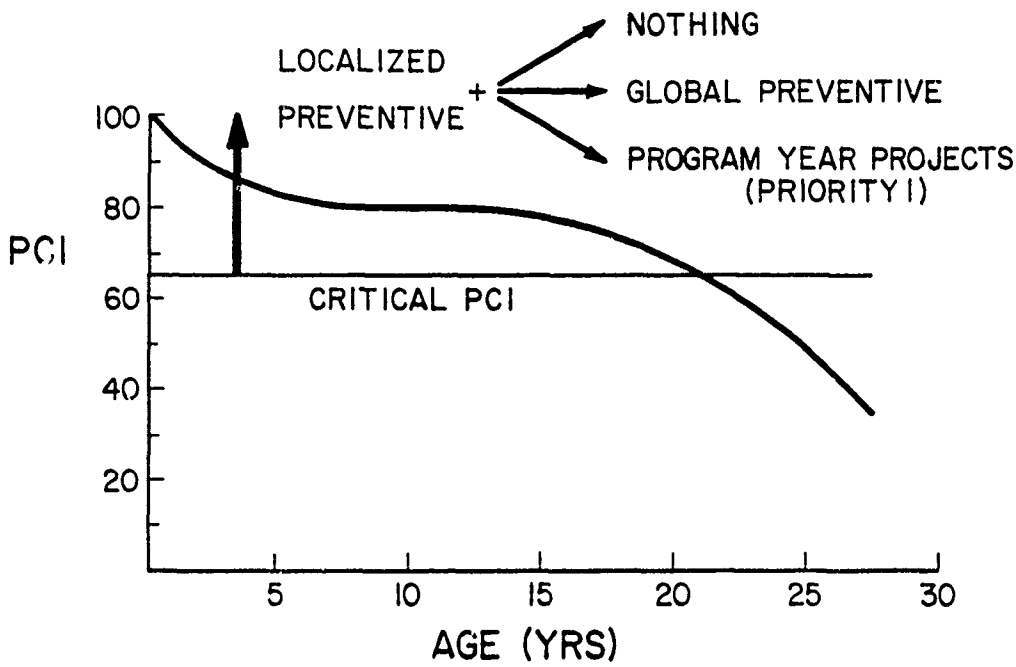

Figure 10. Annual Work Plan, PCI greater than Critical PCI.

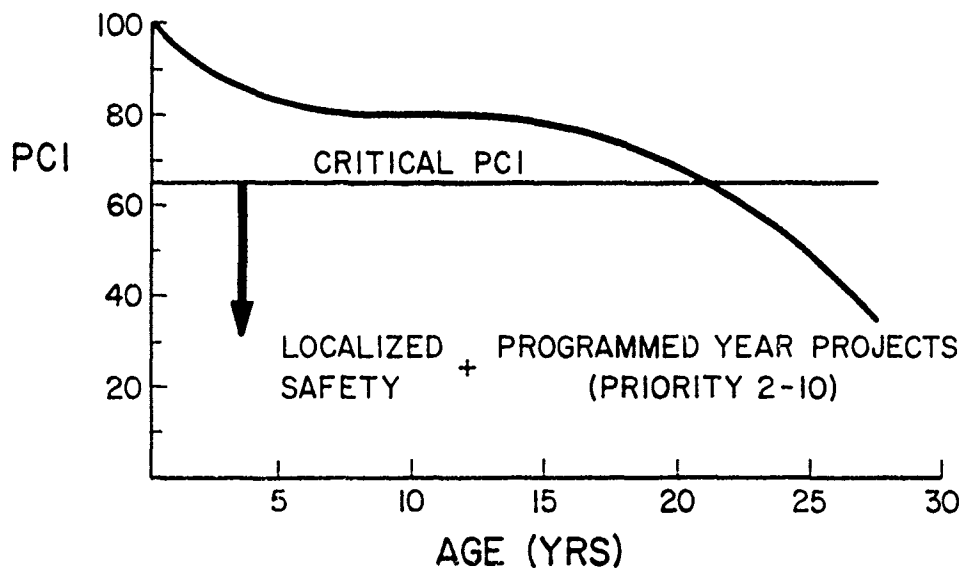

Figure 11. Annual Work Plan, PCI less than Critical PCI.

3.3 Determine major M&R for sections below the Critical PCI by running the BCF Report for all pavement sections below the Critical PCI beginning with the programmed year. The selected minimum PCI should be equal to or greater than the Critical PCI. Since all sections are below the Critical PCI, all sections will show under the programmed year. Examine the list of sections and subtract sections already identified in item 2.2 above.

4. Develop ARR and PYP (Figure 12):

4.1 Add the results of Step 2.1 (localized and global preventive maintenance) and Step 3.1 (localized safety maintenance) to calculate the ARR.

4.2 Add the results from Step 2.2 (the major repairs above the Critical PCI), Step 3.2 (sections approaching the Critical PCI), and Step 3.3 (sections below the Critical PCI).

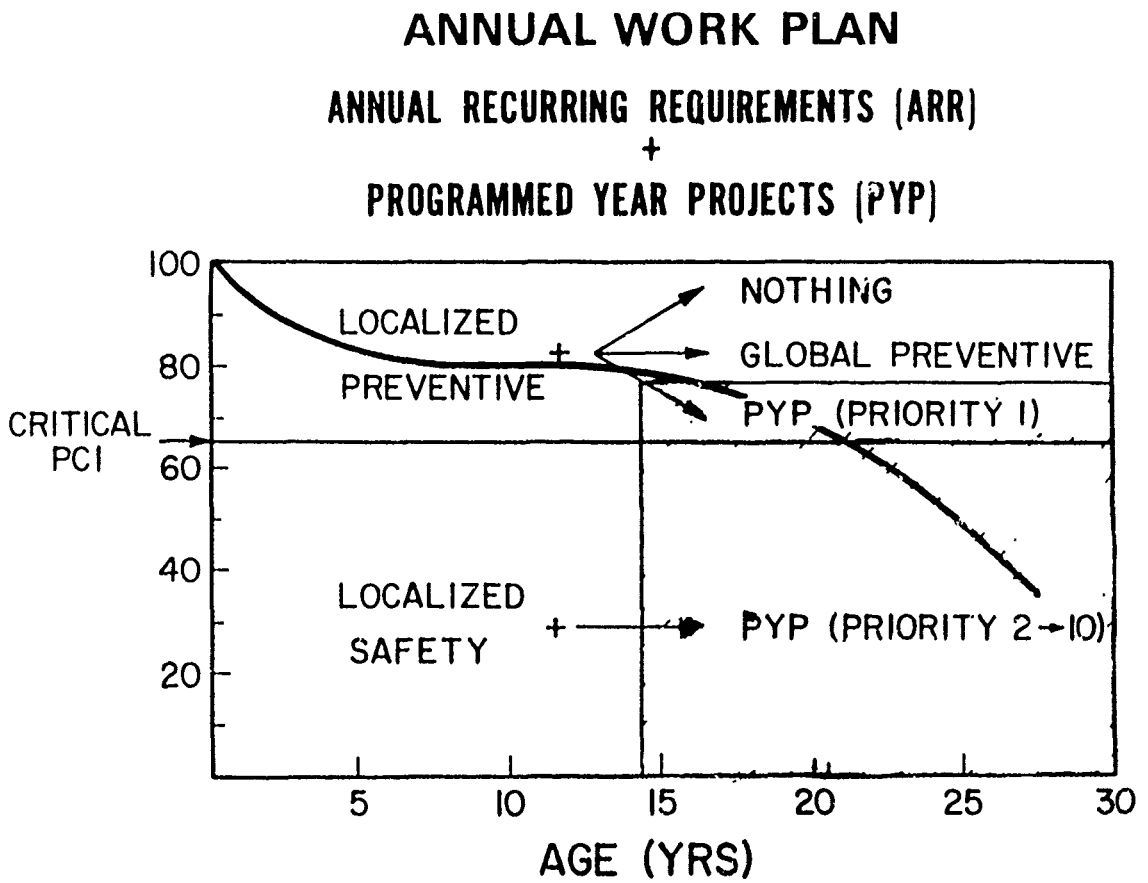

Figure 12. Summary of Annual Work Plan.

AWP Example

The following example illustrates the development of an AWP for a small network of asphalt concrete, family housing roads from an Army installation consisting of eight pavement sections (Figure 13). These pavement sections received a PCI inspection in the fall of 1986.

Step 1.1. The Family Analysis Report deterioration curve was generated for the network (Figure 14). The range for the Critical PCI is 55 to 70.

Step 1.2. The selected preventive and safety policies for the network were generated (Figures 15 and 16, respectively).

Step 1.3. The Network Maintenance Report was generated for pavement sections in the 55 to 70 PCI range using the preventive maintenance policy. The report output is shown in Figure 17. Two sections, 4 and 5, are in that range. The estimated cost of M&R for both sections is not high; therefore, the Critical PCI value of 55 was selected. To demonstrate how preventive maintenance costs increase below the Critical PCI, the preventive policy was applied to these pavements. The results are shown in Figure 18. The M&R costs were high, ranging from to $22,204 to $66,792 per section, with a total estimated cost of $141,131. This finding confirmed the correct selection of the Critical PCI.

Step 2.1. The Preventive Maintenance Report is run for all pavement sections above the Critical PCI of 55 to identify the localized and global preventive maintenance requirements. The total cost of localized preventive maintenance, shown in Figure 19, is $840. The Network Maintenance Report can be used to generate section details with the work type identified for each distress. The global maintenance, shown in Figure 20, indicates that sections 4, 6, 7, and 8 should receive a rejuvenator or fog seal at a total cost of $6,331. (A rejuvenator is the preferred option but a fog seal would be better than nothing.)

Step 2.2. The highest PYP priority is assigned to section 5, which has a PCI of 69. Although this section has a PCI above the Critical value, it was identified by the Preventive Maintenance Report for project evaluation because it has medium severity alligator cracking which is a load related distress. The BCF Report was used to estimate the cost of repair at $7,250 as shown in Figure 21.

Step 3.1. The application of the safety policy to pavement sections below the Critical PCI of 55 is shown in Figure 22. The total cost of safety M&R is $27.

Step 3.2. The BCF Report output for the sections approaching the critical PCI is shown in Figure 23. The cost in year 1 for the annual work plan is 0.

Step 3.3. Priorities for the PYP sections below PCI 55 were assigned using Figure 9. All the sections were classified as priority 10 because they all ranked tertiary and had PCIs below 40. The Budget Planning Report output for the priority 10 classification is shown in Figure 24.

Step 4.1. The total budget for the ARR program was calculated by adding the costs from steps 2.1 and 3.1 for a total of $7,198.

Step 4.2. The total budget for the PYP was calculated by adding the costs from steps 2.2, 3.2, and 3.3 for a total of $89,880.

Figure 25 shows a summary of the AWP work classification for the network. The total AWP is the sum of the ARR and PYP: $97,078. The AWP example has been limited to a small data base for the purpose of demonstration, but the same steps can be easily applied to any size data base. Moreover, this procedure does not preclude the use of engineering judgment; rather, it is intended to facilitate and encourage the use of engineering experience and principles.

SECTION	AGE	PCI
1	27	30
2	27	37
3	27	39
4	21	59
5	21	69
6	2	84
7	2	89
8	2	98

Figure 13. Example PCI Report.

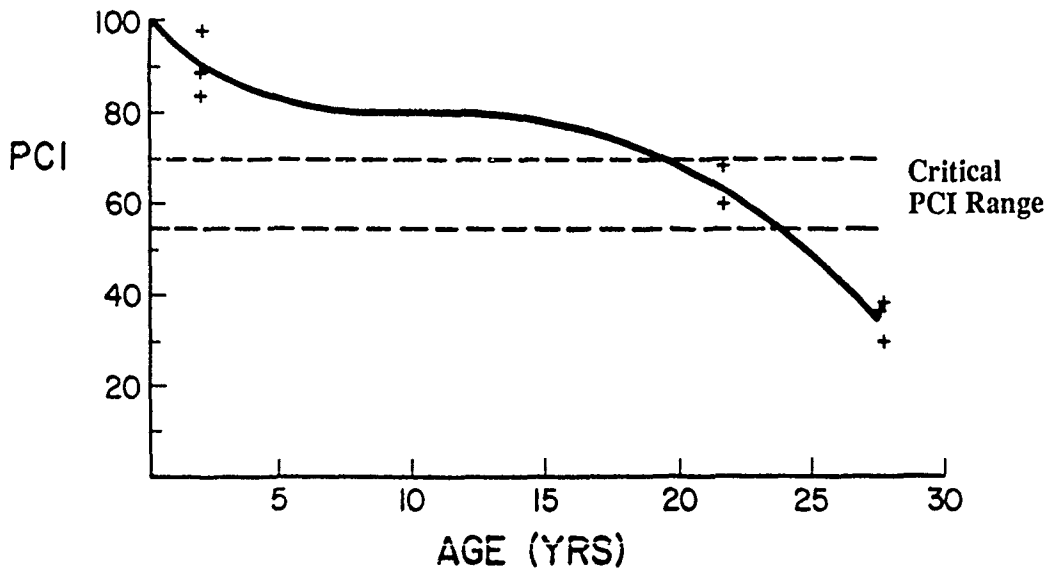

Figure 14. Example Family Analysis Report.

Policy Number: 2 Policy Description: PREVENTIVE , ROADS

Distress	Sev	Work Type & Description	Cost	Unit
1 ALLIGATOR CR	H	PA-AD Patching - AC Deep	5.00	sq. ft.
1 ALLIGATOR CR	M	PA-AD Patching - AC Deep	5.00	sq. ft.
3 BLOCK CR	M	CS-AC Crack Sealing - AC	.60	ft.
3 BLOCK CR	H	CS-AC Crack Sealing - AC	.60	ft.
4 BUMPS/SAGS	M	PA-AS Patching - AC Shallow	2.00	sq. ft.
4 BUMPS/SAGS	H	PA-AS Patching - AC Shallow	2.00	sq. ft.
5 CORRUGATION	M	PA-AL Patching - AC Leveling	1.00	sq. ft.
5 CORRUGATION	H	PA-AD Patching - AC Deep	5.00	sq. ft.
6 DEPRESSION	M	PA-AD Patching - AC Deep	5.00	sq. ft.
6 DEPRESSION	H	PA-AD Patching - AC Deep	5.00	sq. ft.

Distress	Sev	Work Type & Description	Cost	Unit
7 EDGE CR	M	CS-AC Crack Sealing - AC	.60	ft.
7 EDGE CR	H	PA-AD Patching - AC Deep	5.00	sq. ft.
8 JT REF. CR	M	CS-AC Crack Sealing - AC	.60	ft.
8 JT REF. CR	H	CS-AC Crack Sealing - AC	.60	ft.
9 LANE SH DROP	M	PA-AL Patching - AC Leveling	1.00	sq. ft.
9 LANE SH DROP	H	PA-AL Patching - AC Leveling	1.00	sq. ft.
10 L & T CR	M	CS-AC Crack Sealing - AC	.60	ft.
10 L & T CR	H	CS-AC Crack Sealing - AC	.60	ft.
11 PATCH/UT CUT	H	PA-AD Patching - AC Deep	5.00	sq. ft.
13 POTHOLE	M	PA-AD Patching - AC Deep	5.00	sq. ft.

Distress	Sev	Work Type & Description	Cost	Unit
13 POTHOLE	H	PA-AD Patching - AC Deep	5.00	sq. ft.
13 POTHOLE	L	PA-AD Patching - AC Deep	5.00	sq. ft.
15 RUTTING	M	PA-AD Patching - AC Deep	5.00	sq. ft.
15 RUTTING	H	PA-AD Patching - AC Deep	5.00	sq. ft.
16 SHOVING	M	PA-AS Patching - AC Shallow	2.00	sq. ft.
16 SHOVING	H	PA-AS Patching - AC Shallow	2.00	sq. ft.
17 SLIPPAGE CR	L	PA-AS Patching - AC Shallow	2.00	sq. ft.
17 SLIPPAGE CR	H	PA-AD Patching - AC Deep	5.00	sq. ft.
17 SLIPPAGE CR	M	PA-AD Patching - AC Deep	5.00	sq. ft.

Figure 15. Preventive M&R policy.

Policy Number: 1 Policy Description: SAFETY M&R

Distress	Sev	Work Type & Description	Cost	Unit
4 BUMPS/SAGS	H	PA-AS Patching - AC Shallow	2.00	sq. ft.
9 LANE SH DROP	H	PA-AL Patching - AC Leveling	1.00	sq. ft.
11 PATCH/UT CUT	H	PA-AD Patching - AC Deep	5.00	sq. ft.
13 POTHOLE	M	PA-AD Patching - AC Deep	5.00	sq. ft.
13 POTHOLE	H	PA-AD Patching - AC Deep	5.00	sq. ft.

Figure 16. Safety M&R policy.

SECTION	PCI	DIST/SEV	REPAIR	COST $
4	59	LANE SH DROP/M	PATCHING- AC LEVELING	666
5	69	ALLIGATOR CRACKING/M	PATCHING- FULL DEPTH	174
				$840

Figure 17. Network maintenance report for a PCI range of 55 to 70.

SECTION	PCI	COST $
1	30	66,792
2	37	52,135
3	39	22,204
		$141,131

Figure 18. Network maintenance report for PCIs less than 55.

WORK TYPE	SECTION	QTY, SF	COST, $
PATCHING, AC LEVELING	4	665	666
PATCHING, FULL DEPTH	5	68	174
			$840

Figure 19. Localized preventive maintenance list.

GLOBAL PREVENTIVE MAINTENANCE LIST

WORK TYPE	SECTION	AREA (SF)	COST ($)
REJUVENATOR	4	7218	481
	6	30411	2027
	7	28476	1898
	8	28881	1925

PROJECT EVALUATION LIST

SECTION	AREA	PCI	REASON FOR PROJ. EVALUATION
5	16,866	69	ALLIGATOR CR (M)

Figure 20. Global preventive maintenance and project evaluation lists.

YEAR TO REPAIR	SECTION	PRED PCI	AREA (SF)	COST ($)
1990	1	20	31374	40160
1990	2	28	27909	29470
1990	3	31	13329	13000
1990	4	53	7821	3500
1990	5	64	16866	7250
1990	6	53	30411	14750
1990	7	68	28881	11680
1990	8	94	28476	11550

COST TO REPAIR SECTION ON PROJECT EVALUATION LIST

Figure 21. Cost of major repair for sections on project evaluation list.

WORK TYPE	SECTION	QTY, SF	COST, $
PATCHING, FULL DEPTH	1	9	27
			$27

Figure 22. Localized safety maintenance.

YEAR TO REPAIR	SECTION	PRED PCI	AREA (SF)	COST ($)
YEAR 4	7	51	28,476	16,320

Figure 23. Cost of major repair for sections approaching critical PCI.

YEAR TO REPAIR	SECTION	PRED PCI	AREA (SF)	COST ($)
1990	1	20	31,374	40,160
1990	2	28	27,909	29,470
1990	3	31	13,329	13,000
				82,630

Figure 24. Cost of major repair for sections below critical PCI.

TYPE / YR	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6
LOCALIZED PREV MAINT	840	840	840	840	840	840
GLOBAL PREV MAINT	6,331			6,331		
LOCALIZED SAFETY MAIN	27	27	27	27	27	27
MAJOR M&R ABOVE C PCI	7,250					
MAJOR M&R AT C PCI				16,320		
MAJOR M&R BELOW C PCI	82,630					
TOTAL BUDGET	$97,078	$867	$867	$23,518	$867	$867

Figure 25. Summary of annual and long range work plan.

3 LONG RANGE WORK PLAN

Procedure Summary

Although development of long range plans is much simpler than development of annual plans, PAVER can greatly facilitate the process. The long range plan should address the same M&R types addressed in the annual plan.

1. Determine Localized Preventive Maintenance Cost.

The ideal way to project future localized preventive maintenance is to predict the condition of each pavement section and estimate the future needs based on a preestablished PCI vs localized maintenance cost relationship, as shown in Figure 26. The pavement section condition prediction should take into account the scheduled global preventive major M&R. Because this procedure is not automated, the calculations can be tedious. It is acceptable to use the estimated localized preventive maintenance from the annual plan and repeat the value annually.

2. Determine Global Preventive Maintenance Cost.

Global preventive maintenance should be applied every 2 to 5 years to pavements predicted to remain above the Critical PCI. This application should be subject to both engineering and administrative conditions. For example, a rejuvenator should not be used if the pavement has received a slurry seal, and an aggregate seal should not be applied on heavily traveled primary pavements.

Since most PAVER data bases do not include historical global preventive maintenance records, it would be acceptable to use the same estimated dollar value from the annual plan every 3 years until the end of the long range plan period. Once historical records are available, a better estimate would be an average of several past global maintenance costs.

3. Determine Localized Safety Maintenance Cost:

Use the value from the annual work plan and repeat annually. As the network condition improves, this value should decrease and optimally should be close to zero.

4. Determine the Cost of Pavement Sections Reaching the Critical PCI.

The BCF Report output generated in Step 3.2 is used here. The list of sections in each of the years beyond the programmed year should be examined and those sections already identified by the annual work plan for major M&R should be eliminated.

All sections with structural distress and those below the Critical PCI were identified by the annual work plan. No new sections are identified in this area, but if all of the work cannot be completed in year 1 due to budget constraints, the remaining work will move to year 2 and so on.

LRWP Example

Step 1. The Localized Preventive Maintenance cost in the AWP is $840 (Figure 19). This cost is repeated annually as shown in Figure 25.

Step 2. The Global Preventive Maintenance cost in the AWP is $6,331 (Figure 20). Global maintenance will be repeated every 3 years so this cost will be incurred in year 4 as shown in Figure 25.

Step 3. The Localized Safety Maintenance cost of $27 (Figure 22) will be repeated in each year as shown in Figure 25.

Step 4. The BCF Report generated in Step 3.2 is used to determine the cost of pavement sections reaching the Critical PCI. Figure 23 shows that in 1993, section 7 is predicted to have a PCI of 51. The cost to repair this section is $16,320.

Figure 25 shows the summary of the annual and long range work plan.

It should be noted that both the annual work plan and the long range work plan should be updated after performing work or conducting inspections.

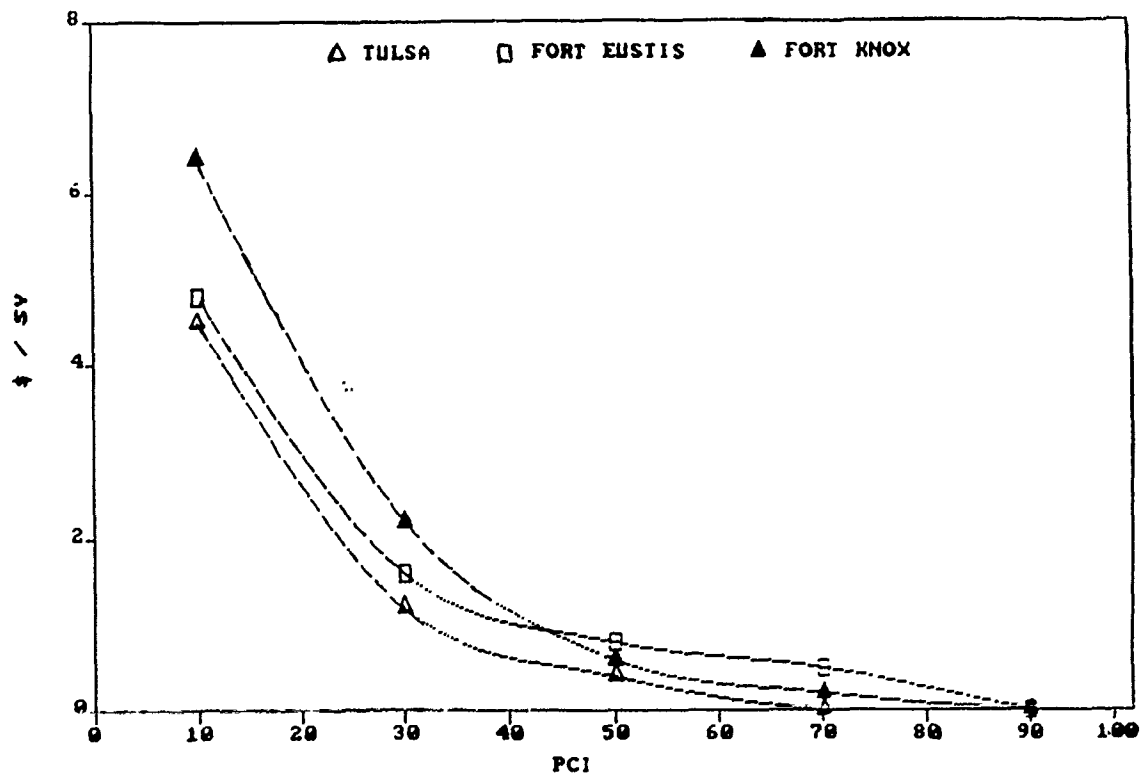

Figure 26. Example PCI vs. localized maintenance cost relationship.

4 DEMONSTRATION

The annual and long range work planning method was demonstrated at three Army installations: Fort Hood, TX; Fort Knox, KY; and Seneca Army Depot, NY. Each of these installations had an existing mainframe PAVER data base. The last inspection at Fort Hood was in 1986-87. The last inspection at Fort Knox was in 1985. Seneca Army Deport was reinspected in 1989 so it had the most current data. These data bases were used to develop annual and long range work plans for the primary road network at each installation prior to the demonstrations.

These installations vary in size from Fort Hood with 652 lane miles of roads to Seneca Army Deport with 189 lane miles of roads. At Fort Hood annual and long range work planning for pavements is done by the Engineering Resource Management Division. At Fort Knox this work is done by Engineering Planning Services Division, and at Seneca Army Depot, it is done by Buildings and Grounds. These divisions were given the demonstration at their respective installations.

The demonstration consisted of explaining the PAVER system and the annual and long range work planning method to DEH personnel. The work plan developed for primary roads was given to the installation and DEH personnel were trained to use PAVER to develop work plans for the remaining roadways.

At both Fort Hood and Fort Knox, primary pavement sections identified for project evaluation by the Preventive Maintenance Report because they were above the critical PCI but beginning to show structural distress, were reinspected during the demonstration. This activity shows the importance of verifying the PCIs for the project evaluation and entering work completed in the PAVER data base. At Fort Hood, for example, the number of sections on the project evaluation list was reduced from 30 to 22.

Feedback from the DEHs indicated that they found PAVER easy to use and useful. The two major points made were: (1) it would help to further automate the annual work plan steps to reduce the DEH personnel time and (2) most DEHs do not have enough personnel to do reinspections in-house and assistance with funds for reinspections is needed to keep the data base current.

5 SUMMARY AND RECOMMENDATIONS

This report provides step-by-step guidelines for developing annual and long range work plans for installation pavements. Use of these guidelines will promote uniformity and allow maintenance and repair requirements to be compared at the major command level. These guidelines meet the requirements for work planning outlined in AR 420-72.

One recommendation that resulted from this demonstration was that the process of developing annual and long range work plans be further automated to be a single PAVER system report. This would save time for DEH personnel. Another recommendation is that the family curve prediction method be incorporated into the PAVER system reports. Currently the reports use a straight line prediction method which yields less accurate results.

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